

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re patent application of

Wilhelm BARUSCHKE et al.

Corres. to PCT/EP2004/010209

For: AIR-CONDITIONING SYSTEM PROVIDED WITH A HEAT PUMP

TRANSLATOR'S DECLARATION

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

I, the below-named translator, certify that I am familiar with both the German and the English language; that I have prepared the attached English translation of International Application No. PCT/ EP2004/010209, and that the English translation is a true, faithful and exact translation of the corresponding German language paper.

I further declare that all statements made in this declaration of my own knowledge are true and that all statements made on information and belief are believed to be true; and further, that these statements were made with the knowledge that willful, false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful, false statements may jeopardize the validity of legal decisions of any nature based on them.

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Date: March 15, 2006



Name: Kenneth John STEWART

For and on behalf of RWS Group Ltd

## AIR CONDITONING SYSTEM HAVING A HEAT PUMP

The invention relates to an air conditioning system, in particular for a motor vehicle, according to the preamble of claim 1.

An air conditioning system of such type is known from DE 36 35 353, in which the air conditioning system can also be operated as a heat pump, the energy which needs to be fed to the refrigeration circuit originating from the energy losses of the motor vehicle, that is to say from the hot coolant heat energy which is otherwise discharged, without being utilized, to atmosphere via the radiator of the motor vehicle. For this purpose, a heat exchanger is provided which, during heating operation of the air conditioning system, serves as an evaporator for the refrigerant, the energy for evaporation of the refrigerant being taken from the hot engine refrigerant, so that the coolant is evaporated through utilization of the coolant energy.

An air conditioning system of such type can however be improved.

It is an object of the invention to provide an improved air conditioning system.

This object is achieved by means of an air conditioning system having the features of Claim 1. Advantageous embodiments are the subject matter of the subclaims.

According to the invention, an air conditioning system, in particular a motor vehicle air conditioning system, having a circuit is provided, in which circuit are arranged a refrigerant compressor, a gas cooler, an inner heat exchanger, an expansion element and an evaporator, a device for reversing the flow direction

of the refrigerant being provided for heat pump operation, and means being provided which deactivate the inner heat exchanger while the flow direction is reversed. In normal operation, that is to say in AC  
5 operation, the refrigerant flows from the gas cooler (first heat exchanger) to the expansion element, and from the evaporator (second heat exchanger) to the refrigerant compressor, are thermally coupled by means of the inner heat exchanger. In heat pump operation,  
10 however, the inner heat exchanger is bypassed, so that there is no thermal coupling between the refrigerant flows. The entire arrangement makes possible a simply constituted heat pump without additional components in the refrigerant circuit.

15 The means which deactivate the inner heat exchanger while the flow direction is reversed preferably comprise two non-return valves which are arranged in corresponding lines provided in parallel with the inner  
20 heat exchanger. Here, the non-return valves can also be provided on or in the inner heat exchanger.

The device for reversing the flow direction is preferably formed by means of a suitable means of  
25 switching to a cross-over circuit of the back pressure and high pressure connections on or in the refrigerant compressor.

An expansion element having two antiparallel bypasses  
30 is preferably provided in the circuit. This is preferably an orifice expansion element having two flow-direction-dependent antiparallel bypasses.

The evaporator assumes the heating function during heat  
35 pump operation.

CO<sub>2</sub> is preferably used as the refrigerant. Other

refrigerants are however also possible.

A compressor regulator valve and a device for switching the refrigerant flow direction are preferably  
5 electrically controlled.

An adjustable stroke volume of the refrigerant compressor for controlling the refrigeration power (AC operation) and the heating power of the heat pump is  
10 particularly advantageous.

The invention is described in detail in the following on the basis of an exemplary embodiment and with reference to the drawing, in which:

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Fig. 1 shows a schematic illustration of an air conditioning system according to the invention in AC operation, only those components relevant to this operating  
20 state being illustrated, and

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Fig. 2 shows a schematic illustration of the air conditioning system from fig. 1 in heat pump operation.

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An air conditioning system 1 has a circuit 2 having a refrigerant compressor 3, a first heat exchanger 4 which is connected downstream of said refrigerant compressor 3 and serves as a gas cooler in AC  
30 operation, an inner heat exchanger 5, an expansion element 7 having two antiparallel bypasses, and a second heat exchanger 8 which serves as an evaporator in AC operation.

35 Refrigerant flows clockwise through the circuit 2 in AC operation, as illustrated in fig. 1. In the inner heat exchanger 5, heat is exchanged here between refrigerant

coming from the first heat exchanger 4 and refrigerant coming from the second heat exchanger 8.

If there is a change in mode to heat pump operation by means of a cross-over circuit of the back pressure and high pressure connections on or in the refrigerant compressor 3, the inner heat exchanger 4 is deactivated on account of non-return valves 9 arranged in corresponding lines. On account of the reversed throughflow direction, as illustrated in fig. 2, flows passes through the circuit 2 counter-clockwise. Here, the first heat exchanger 4 assumes the function of an evaporator and the second heat exchanger 8 acts as an additional heater.

The expansion element 7 embodied by means of two antiparallel bypasses can be used without external control measures in both operating modes, that is to say in AC operation and in heat pump operation.

**List of reference designations**

- 1 Air conditioning system
- 2 Circuit
- 3 Refrigerant compressor
- 4 First heat exchanger
- 5 Inner heat exchanger
- 7 Expansion element
- 8 Second heat exchanger
- 9 Non-return valve
- 10 Line